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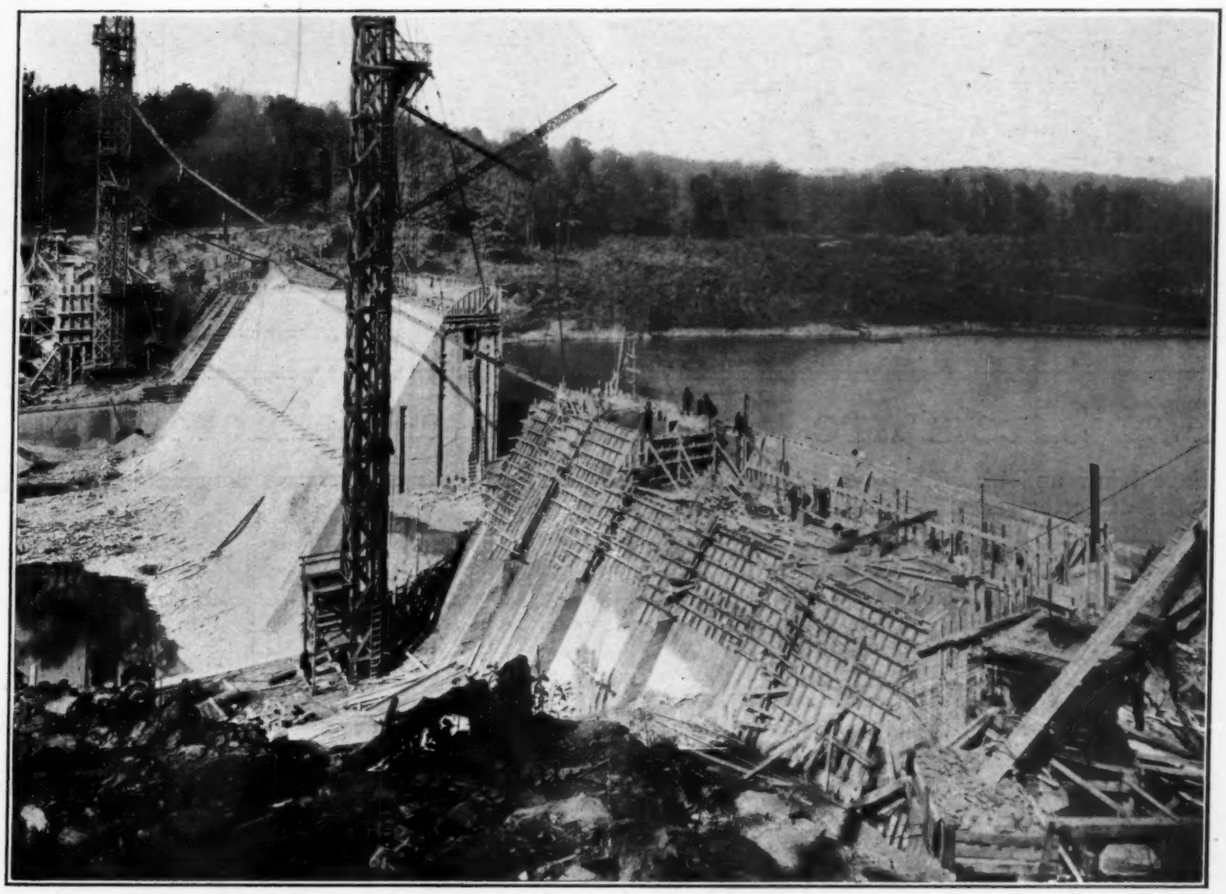

LOCH RAVEN DAM, BALTIMORE. SPILLWAY SECTION NEARING COMPLETION; MIDDLE SECTION, LEFT OPEN TO PASS FLOOD WATER, SHOWS EXPANSION JOINT WITH BONDING GROOVES AND UPPER INSPECTION GALLERY.

IN THIS ISSUE

Construction of Loch Raven Dam
Dallastown Asphalt-Concrete Highway
Odor Elimination at New Bedford Garbage Plant
Excavating Clay with Pneumatic Tools
Concrete Plant for Springfield Bridge

JUNE 17, 1922

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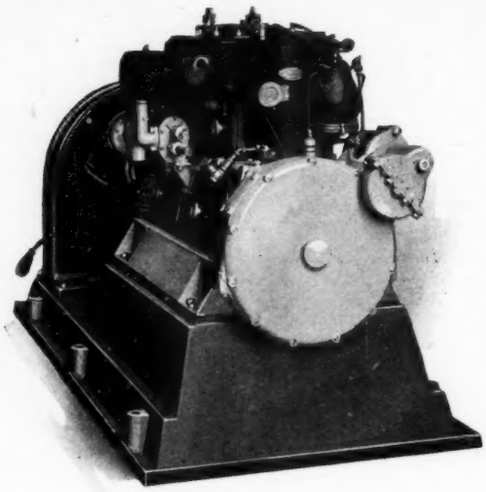

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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 June 17, 1922 No. 24

Construction of Loch Raven Dam*

By Wm. A. Megraw†

Raising a dam fifty-two feet, using concrete chuted to place from one end. Gravity and machinery used in plant with considerable saving in labor. Provision for draining joints and inspecting seepage. Total cost of dam exceeds a million dollars.

Baltimore is engaged in making what is known as the Gunpowder improvement to its water supply. The plans include a dam at Loch Raven, on the Gunpowder river, to impound 23 billion gallons of water, and a balancing reservoir to limit the pressure on a 7-mile tunnel conducting water from the dam to the filter plant, together with the necessary relocation of roads and bridges, the purchase and removal of the villages of Warren and Phoenix, the relocation of 1.5 miles of Pennsylvania Railroad tracks near Phoenix, the purchase of about 4,000 acres of land from 54 different owners, and clearing buildings, trees and vegetable matter from the ground to be flooded.

DESIGN OF THE DAM

The principal feature is the Loch Raven dam, which is nearing completion. Plans for this were first prepared in 1913 and the work completed during the following year to elevation 188 feet above mean tide, the base being made broad enough to support an additional section which it was proposed to add later to raise the dam to elevation 270. The plans under which the present contract is proceeding provide for raising the dam from elevation 188 to elevation 240.

The dam is a solid concrete structure, 640 feet long over all, with a spillway 288 feet long and rising about 103 feet above bed rock.

In designing the cross section, an upward pressure was assumed on all horizontal joints, equal to the full hydrostatic pressure at the upstream face and decreasing to zero at the downstream face. Porous drains in the horizontal joints are provided to relieve this upward pressure. Two 48-inch pipes passing through the old foundations control the ordinary flow of the river and enabled all concrete to be deposited on dry surfaces. One-inch bent steel rods, spaced five feet apart horizontally and vertically, are imbedded three inches back of the down-stream face and can be straightened to assist in binding the new concrete to the old in case the dam is ever raised to a higher elevation.

The gate chamber is divided into two separate compartments, each of which is designed to supply the city separately. Fifteen sluice gates, 3½ feet by 6 feet, arranged at different heights, control the entrance of water.

GENERAL LAYOUT OF WORK AND PLANT

The dam is located between steep hillsides and the available working space is small. Stone was furnished from a city quarry located on the west side of the river 3,000 feet down stream from the dam. An improved highway extends from a point on the hillside opposite and above the dam down to and past the quarry to Loch Raven Station on the Maryland and Pennsylvania Railroad about 2,200 feet further down and about eleven miles from Baltimore. The railroad at Loch Raven Station is approximately at right angles to the river and follows along a steep hillside about 50 feet above the highway, which turns and parallels the railroad in both directions. A siding about 1,600 feet west of the railroad station provides a means of handling materials from the railroad by gravity to the highway below. An old city-owned siding 1.6 miles long is located on the east side of the river and extends from the dam southerly to a point where the railroad, 1.2 miles east of Loch Raven Station, meets it at grade. This arrangement of highways, railroads and sidings, offered several means of handling the work of construction.

The contract was awarded to the Whiting-Turner Construction Company of Baltimore on April 6, 1921, and about July 1, the first concrete was deposited. The bulk of the work was completed by January 1, 1922.

The specifications permitted the use of cyclopean concrete, but the contractor installed a chute system for distribution, which precluded the depositing of large stones, except in the east shore section, where a derrick, used for excavating the east abutment, swung a portion of the larger stones into the dam.

*Paper before the American Water Works Association.
†Water Engineer, Baltimore Water Department.

The chute system was designed by the Lakewood Engineering Company.

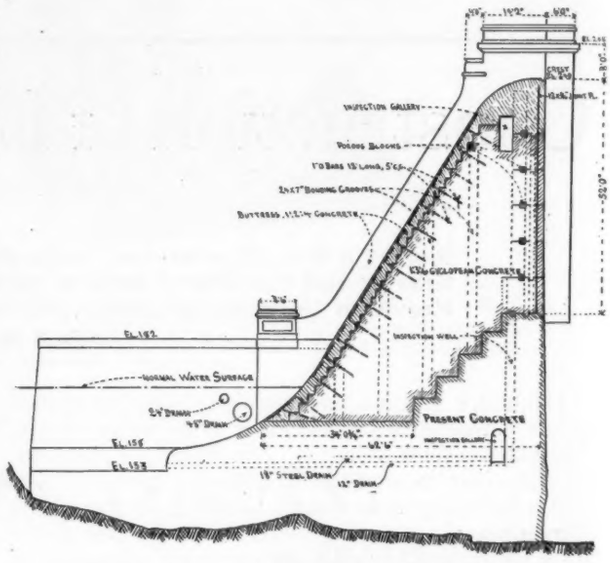
On the west side of the river, the topographical conditions were ideal for a gravity plant. The contractor, availing himself of this advantage, located his crusher, storage bins and mixing and distributing plant up and down the west hillside just south of the site for the dam, although the city siding on the opposite side of the river connected the dam directly with the main line of a railroad.

Cement was the only material hauled by railroad. On the hillside below the siding at Loch Raven Station a cement house was built with a capacity of 5,000 barrels. The cement was here received in bags and handled by a belt conveyor operated by a gasoline engine which also operated a bag shaker consisting of a wire cage rotating about 7 minutes for each charge. By means of a chute the bags of cement were passed to trucks, which transported the cement to a 200-bbl. capacity shed located on the hillside above the plant, whence it was conveyed directly to the mixer platform by chutes.

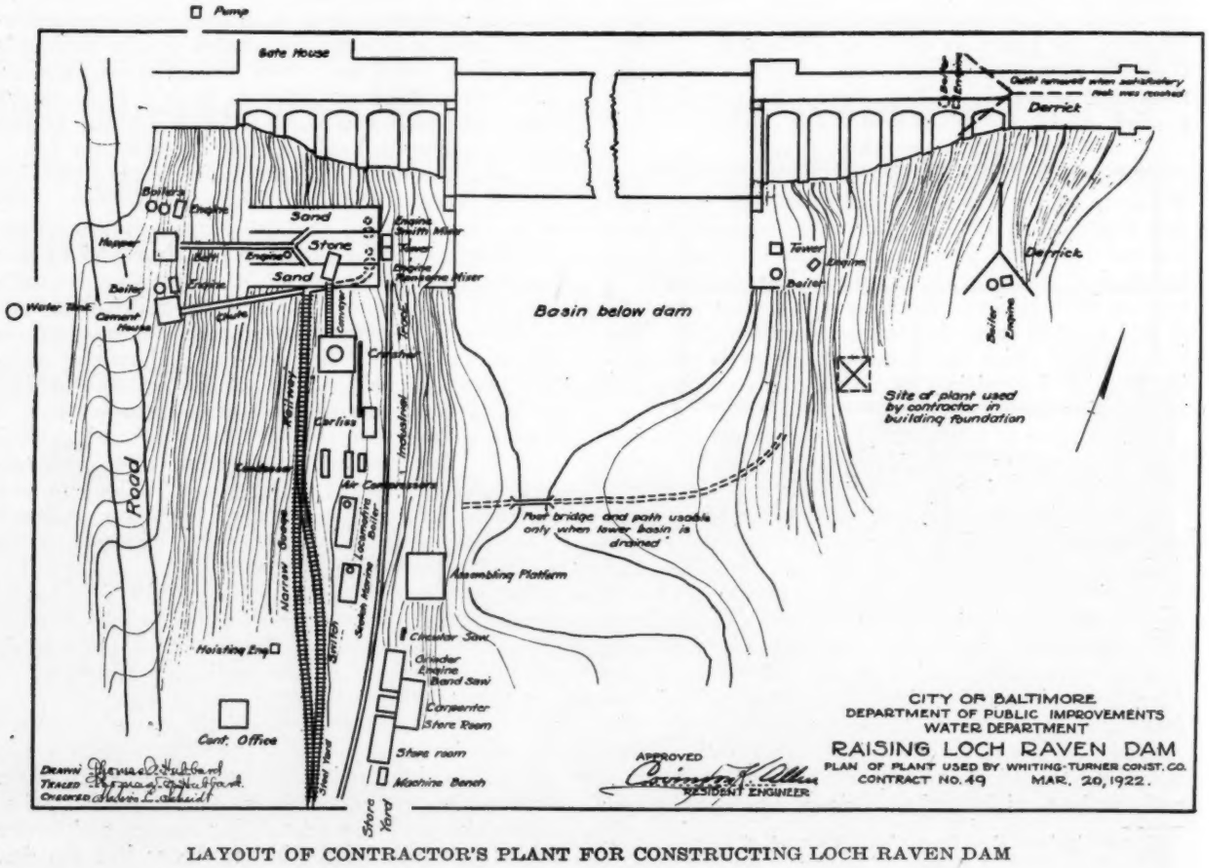
OBTAINING SAND AND STONE

The neighborhood sand is generally not suitable for concrete, but the contractor was able to locate an excellent sand pit about 2 miles from the dam. The cost of this sand at the pit was 24c. per cubic yard and the cost of trucking 44c. per cubic yard, making a total of 68c. for the sand delivered. The quotation for river sand shipped from Baltimore was 70c. per ton plus $1.14 for freight, which is the equivalent of $1.45 per cubic yard. The contractor was thus saved 75c. per yard and the delays consequent to rail shipment. The sand was excavated by a three-quarter yard revolving steam shovel and transported by motor trucks to a point above the plant and dumped directly into a hopper at the elevation of the highway, from which a belt conveyor carried it to two large storage bins, one of which is located on each side of the stone bin. The total capacity of the two bins is 500 cubic yards.

The sand contained a maximum of 10 per cent



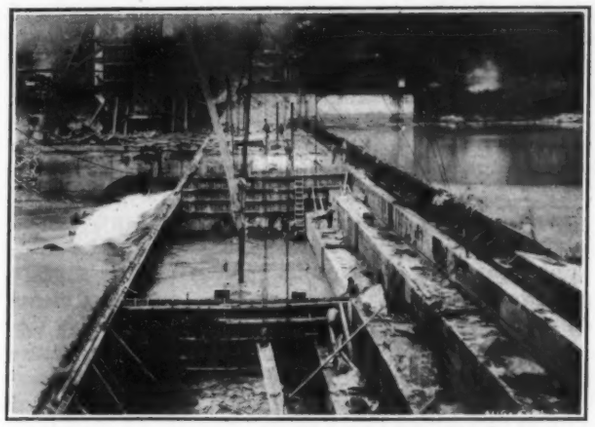
CROSS-SECTION OF LOCH RAVEN DAM



LAYOUT OF CONTRACTOR'S PLANT FOR CONSTRUCTING LOCH RAVEN DAM

of clay, which was twice the amount authorized by the specifications, but it was accepted after thorough tests had been made, one to three mortar briquettes showing an average of 250 pounds per square inch, which is 50 pounds above the standard requirement. At different times, as the work progressed, 4-inch cubes were made from concrete as it passed from the chutes into the dam. The compressive strength of these cubes at the end of 28 days averaged 1,800 pounds for 1-3-6 concrete and 2,200 pounds for 1-2-4 concrete. The sand was well graded from small to large and contained a considerable percentage of gravel for which reduction was made in the stone. The clay seemed to lubricate the concrete, causing it to be more easily mixed, chuted and worked. The concrete produced a smaller amount of laittance than is usual and honeycombing is almost entirely absent from the dam.

The stone was taken from the city quarry with no expense other than that of actual quarrying. For each blast, two large well drillers were used to put down about 10 holes 12 feet apart and 85 feet deep, located parallel to and 20 feet back of the quarry face. Three large blasts, each requiring about 4,200 pounds of dynamite, made at different times as the work progressed, were required to throw down the necessary 45,000 yards of rock. After each shot, considerable secondary drilling was done by various kinds of drills, and tripod and jackhammer, besides a large amount of mud capping, in order to reduce the stone to steam shovel size. The air used by the drills was piped from a power plant located below the dam. A ¾-yard Erie shovel used at the beginning of the job soon proved insufficient and was replaced by a 90-ton Marion shovel for loading the stone into dump cars.



CONCRETE BINS, MIXER AND TOWER AT LEFT BACKGROUND; FACE FORMS TEMPORARILY BRACED IN POSITION

The cars were hauled a half mile to the dam over a 36-inch gauge track by an 18-ton dinkey, four cars constituting a train. As the track approached the dam, it was elevated on a trestle at 5.8 per cent grade, permitting dumping directly into a 1,500-ton gyratory crusher. A hoisting engine was used to spot the cars up the incline to the front of the crusher, which enabled the locomotive to return for another train while the first trainload was being dumped and crushed. From the crusher the broken stone was raised to an overhead bin by means of a belt conveyor. The stone bin has a capacity of 1,000 cubic yards and is located between the two sand bins.

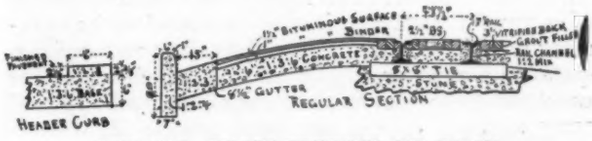
(To be continued)

Dallastown Asphalt-Concrete Highway

Construction of about 1.1 miles of sheet asphalt pavement on cement concrete base with concrete curb and gutter. Details of labor.

Route 216 of the Pennsylvania State Highway System, in York county, is 5,786 feet long and has a uniform concrete base covered with a sheet asphalt wearing surface, the total thickness being 8½ inches. It extends on each side of the street car tracks to a concrete gutter 15 inches wide and 8½ inches thick, which in turn extends to the 7x20-inch concrete curb. The rails and ties are laid on broken stone ballast and the spaces between and on both sides of the 7-inch rails are paved with 3-inch vitrified brick with grout filler. Between the tracks the narrow strip, edged on both sides with paving brick, is finished with 2½-inch thick bituminous surface. The rails are set in 1:2 cement mortar. The maximum grade is 5.69 per cent. and the maximum curveture is 11 degrees 30 minutes.

The contract was awarded to the A. P. Kroft Construction Co., York, Pa., which commenced operations July 25, 1921, and finished the work the same fall. The concrete curb was first laid and was built in accordance with the Pennsylvania State Highway standards, except that the thickness was, by special request of the borough, made 8½ inches instead of the usual 6 inches. It was concreted in 10-foot sections in forms made of 2-inch surface planks. A gang, consisting of one foreman, one mixer operator, 5 skilled laborers and 20 common laborers laid an



TYPICAL CROSS-SECTION OF ROAD

average of 330 feet per 10-hour day and completed 11,570 linear feet in 37 days with the use of one ½-bag concrete mixer and two trucks.

The grading, involving 4,626 yards of excavation, besides that for the track foundations, which was done by the York Railway Co., was commenced August 18 by a Keystone steam shovel with a ½-yard bucket, served by four automobile trucks. The work was done by a force of one foreman, two skilled laborers and twelve common laborers. The subgrade was crowned parallel to the finished surface and was thoroughly compacted by a 10-ton steam roller manufactured by the Harrisburg Foundry Co.

On August 26th the construction of the concrete gutter was commenced which, like the curb, was built in sections 10 feet long, the entire amount of 11,570 linear feet being made in about 42 days by a gang consisting of one skilled laborer, twenty common laborers and a foreman, served by one truck and one ½-bag mixer.

Concreting the base course was commenced September 26th. Header curbing was first placed at all street intersections. Sand was procured locally and from the Arundel Corp., Baltimore. Stone was secured from local dealers and both sand and stone were stored in stock piles where they were loaded by a Jeffrey type K loading machine and by the steam shovel which served a fleet of seven 1½-ton Autocar trucks, in which the aggregate was transported to a Rex mixer and a Koehring mixer, each of two bags capacity. Each truck was divided into two compartments and carried two batches each containing 6 feet of sand and 12 feet of stone. Cement was stacked in piles along the street and dumped by hand into the skips. Concrete was mixed about one minute with from 14 to 20 revolutions of the drum. Each concrete gang consisted of five skilled laborers, ten common laborers, and a foreman. The surface of the concrete was finished to template and left slightly rough, but not open. Construction joints were made at the end of each run by a wooden bulkhead. The total amount of concrete base was 16,842 square yards which was laid with the two machines at an average rate of 1,200 square yards per 10-hour day.

The 1-inch binder course laid on the concrete base was proportioned 4.7 per cent. asphalt cement, 16.6 per cent. sand and 78.7 per cent. stone. The binder was mixed at a plant about 8 miles from the site and the material was hauled to the job by five 5-ton trucks, each carrying an average load of 4.5 tons of hard material at the usual temperature of about 275 degrees Fahrenheit and delivered at the job.

The 1½-inch wearing surface was proportioned 10.4 per cent. asphaltic cement, 11.6 per cent. limestone dust and 78 per cent. sand. Like the binder, it was mixed and heated at the remote plant and delivered by trucks reaching the site at a temperature of about 225 degrees Fahrenheit. The asphalt top courses were finished by an 8-ton Iroquois roller, and a gang of four skilled laborers, three common laborers and one foreman equipped with one wagon and five 5-ton trucks, made an average of 1,500 square yards of pavement per 10-hour day. The work was executed for and under the direction of the Pennsylvania State Highway Commissioner, with assistant engineer G. Van Riper in charge when the work was completed.

Engineers' Plans for State Health Boards*

Regulations of State Boards of Minnesota, Mississippi, Montana, and Nebraska, with respect to the contents and form of plans and reports requested to accompany applications for water and sewerage permits.

Minnesota—Before any plans for water supply, sewerage or refuse disposal are prepared, the State Board of Health should be notified and it will investigate conditions and report to all interested parties as promptly as possible, stating the requirements of the Board for this particular case, which should be observed in preparing the plans. Duplicate copies of plans should be sent to the Board. If they are not found satisfactory the engineer is notified and given an opportunity to change them before the matter is officially reported to the authorities. A municipality should furnish to the Board in writing its authorization of the engineer to submit the plans.

Approval of plans does not include approval of structural features of design, such as thickness of concrete or efficiency of any mechanical equipment. The Board reserves the right to withdraw approval of a system whenever it may be found to be operating unsatisfactorily. Since the safety and sanitary quality of a water supply depend largely upon the construction to prevent contamination, final approval of any water supply cannot be given until after its completion and inspection.

Water Supply.—There is required a map, scale between 100 and 300 feet to the inch, showing source of water supply, pumping stations, reservoirs, filtration plant, and location and size of each main. Plans shall show in detail all new work and connections to existing system, drawn to such a scale as to show clearly all details.

Sewerage—A map showing entire sewerage district, drawn to a scale between 100 and 300 feet to the inch; showing all salient topographic features, and 5-foot contours; also elevations of surface and sewer pipe at street intersections "unless a complete set of profiles is provided." Location of sewage treatment plant and outlet should be shown. Plans shall show clearly all essential details of the design. If the map does not show clearly surface and sewer elevations and grades and sizes of pipe, profiles shall be submitted. Elevations of unusually deep basements shall be shown.

The Board has no jurisdiction over storm sewers.

*Continued from page 427.

The provision as to minimum grades found in the Arkansas rules are given (see page 323), with the additional provision that in no case shall the grades be less than .33 ft. per 100 ft. for 6-inch, 0.25 ft. for 8-inch; 0.23 for 10-inch, etc., down to 0.08 for 24-inch. Engineers are cautioned against "specifying pipes of sizes which are obviously larger than necessary for carrying capacity, but which are used in order to meet grade requirements."

In addition to the above, the instructions of the Board contain rather extensive statements of features of design of both water supply and sewerage systems that must be avoided. These will be published later as a separate article.

Mississippi—The regulations of this Board specify only that there shall be furnished "complete plans and specifications for the installation, together with such information as the State Board of Health may require," submitted in duplicate. "Plans for sewerage systems shall include the sewer system and disposal plant, give information regarding the stream into which the effluent is to be discharged" and provide for the entire community and for its reasonable growth.

Montana—The regulations of this Board are the same as the Arkansas ones with the following exceptions (and a few other minor ones): Maps for sewerage or water works systems may be as small as 600 feet to 1 inch. "A small scale map of the catchment area shall be furnished compiled from actual surveys if such have been made or from maps of the Geological Surveys if such have been extended over the country, otherwise from the best data obtainable. Such map should show the relative locations of towns, villages, mines or other settlements which may affect the sanitary condition of the watershed or the future quality of the water supply." Under the head of "Wells and Collecting Galleries" there is added: "There shall be a map showing the location and extent of the ground that is controlled by the municipality or company making the development and the nearest source or sources of possible certain water shown thereon. Profiles shall have a horizontal scale of 100 ft. to 1 in.

In "Information Concerning Sewer Systems," there is the additional item: "Distance of sewage outlet from shore and depth of water at outlet if outfall discharges into a large stream."

Nebraska—Plans "shall be submitted in the form of blue prints in triplicate, and shall be accompanied by three copies of specifications and three copies of an engineer's report on the subject." There is required, for water works, a map showing principal topographical features, streets, boundary lines of improvement districts, location and size of mains, and other features as specified by the other state boards, to be drawn to a scale of not less than one inch to 300 feet. Also detail drawings of pump houses, treatment plants, wells, intakes, and all appurtenances. In the case of ground water a graphic log of the well to be used or of the test hole, and in the case of surface supply a small scale map of the drainage area. For sewerage systems there are required a map of district to be served, same scale as above, and showing sewers and other features, with contour lines at not more than 5-foot intervals, or 2-foot where grades are light. Also profile and plan of each sewer, showing size, grade, appurtenances, etc. Also detail drawings of all appurtenances.

"The engineer's report shall include a comprehensive statement of the conditions obtaining in the locality of the proposed work," including population, expected growth and all others that have an important bearing on the problem. It shall discuss, for water works, the needs and resources, mineral and sanitary characteristics of the proposed supply and facts and data on which the design is based; for sewerage, ultimate disposal, danger of nuisance, and the facts and data on which the design is based.

Water-Borne Typhoid in Havre

Following serious typhoid epidemics in Havre, France, during recent years, studies of the cause were made by a number of scientists, and one of these, Dr. J. Sanarens, has recently published his conclusions, which contain a number of interesting points. He bases his conclusions very largely upon a sanitary survey of the entire watershed rather than upon merely laboratory tests and conclusions.

Havre's water supply is drawn from a zone of chalk surmounted with a limestone layer which is less fissured, and with diaclase, generally mixed with clay and sand. The waters have their origin in channels or small subterraneous streams. These apparently receive impure, unfiltered water from the surface, especially during periods of heavy rain. In dry periods the waters are remarkably free of micro-organisms, there being few cities in France provided with water as pure bacteriologically. Following heavy rainfalls, however, the water becomes turbid and comparatively high in bacteria, apparently proving pollution by impure ground waters. A study of previous epidemics showed that the curve of cases approximately paralleled that of the annual yield of the source of the water supply as well as that of the temperature of the water and air. The maximum number of cases has always occurred in August and September after the most violent rainfalls of the warm period; while the least typhoid fever occurred after periods without rain. After torrents, the increase of typhoid fever cases generally occurred from 10 to 25 days after the rain, a time which corresponds to the period of incubation of typhoid fever. These observations are based upon the experience of twenty years.

A number of interesting investigations and tests are referred to in the report. In water artificially sown with typhoid bacilli without the presence of the normal saprophytic organisms, the typhoid bacillus, exposed to diffused north light or in the dark, was found to live more than 100 days, when the water was not renewed in the test container and when culture was used containing very little organic matter. This is probably the limit of practical conservation, for after 100 days the cultures were difficult to obtain and often failed to develop. The experiments of Dr. Pottevin show that in calcined sand the bacillus has been able to live for seven months on this support, in a current of Havre limestone waters.

Discussing indol formation, the author points out that he had been able to show by numerous tests that B-coli coming from the human intestine generally gives a very strong reaction with violet-red

coloration deepened by the nitrite-sulphuric acid reagent; but that B-coli from the intestines of herbivorous animals give on the contrary generally a pink-orange coloration.

An unusual method was employed for determining how rapidly surface infiltrations reached the underground water supplies. In order to avoid arousing the water takers' antagonism, only small amounts of fluorescin could be used, and these tests were negative. It was then decided to use brewers' yeast, since experiments had indicated that saccharomyces derevisiae were not normal inhabitants of the water, although very dissimilar yeast-like growths were found. Brewers' yeast thrown on the surface of the ground on various roadways was found in the water from 6 to 48 hours after being so spread, thus indicating that surface water seeps into the underground streams at some points with considerable rapidity.

Odor Elimination, New Bedford Garbage Plant

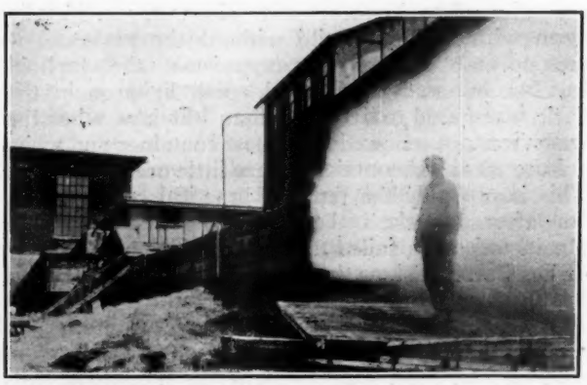
By W. J. Springborn

An installation made by the writer in November, 1921, in the New Bedford, Mass., municipal garbage reduction plant may be of interest to city authorities, not only from the standpoint of the elimination of obnoxious odors, but also because such elimination of odors has made possible a notable increase in the efficiency of the plant.

The Cobwell system of garbage reduction was used at New Bedford, in which the raw garbage is placed in sealed tanks, covered with a solvent (gasoline), and cooked for a period of twelve hours to break down the organic structure and dehydrate the material so that the valuable constituents may be recovered in the form of grease and tankage.

The city of New Bedford had outgrown the capacity of this plant, so that at times it was unable to care for all of the city garbage, even when operating on a twenty-four hour schedule.

At about this time Prof. Yandell Henderson of Yale University, together with his associate, Dr. Howard W. Haggard, made the discovery that obnoxious organic odors could be destroyed by a simple and inexpensive treatment with chlorine gas, and preliminary experiments conducted in a Cleveland plant in co-operation with the writer indicated the process could be installed on a commercial basis.



EXHAUST FROM DIRECT HEAT GARBAGE DRYER AT NEW BEDFORD GARBAGE REDUCTION PLANT

It has long been known that direct-heat drying of garbage is more economical than cooking, pressing and drying, but this method has not generally been employed because of bad odors generated by the driers. In view of this new deodorizing development, it was decided to install a direct-heat rotary type drier at New Bedford, for preliminary treatment of the garbage before placing it in the Cobwell reducers, and thus reduce the time required for driving off the moisture and degreasing the material, thereby increasing the capacity of the plant, and to overcome the odors created by the drier by the process developed by Professors Henderson and Haggard.

In this plant a duct carried the vapors from the driers outside the building and discharged them at ground level so that close observation could be had of the odor control. The deodorizing equipment consists of a special type of Wallace & Tiernan control apparatus, through which volatilized gas from liquid chlorine is passed into a mixing chamber, thence into the duct. The velocity of the vapors through the duct is such that about seven seconds of contact between the chlorine and the odor-bearing gases is maintained. Since installation, complete elimination of odors from the drying of garbage has been effected with a chlorine consumption of less than eight pounds per day. During the months of December, 1921, January, February, March and April, 1922, 900 pounds of chlorine gas was used costing seven cents a pound, or $63 as a total cost to deodorize the vapors from 4,098 tons of garbage, an average cost of 1.5 cents per ton of garbage treated.

By using the drier installation it has been possible to increase the capacity of the plant by fifty per cent., the cooking period in the Cobwell machines being reduced from about 12 hours to 3 hours.

Not only has the plant capacity been increased, but economies have been effected in several items of operating cost. The following comparative figures have been given out by C. M. Schindler, superintendent of the plant, covering periods before and after installation of the drier:

Before Drier Installation

December, 1920—January and February, 1921

	Total	Per Ton
Garbage treated	2,433 tons	
Coal	527 gr. tons	485 pounds
Solvent used	29,082 gallons	11.95 gal.
Power and light	$2,114.35	$0.87
Labor costs	$7,473.90	$3.07
Water	$ 30.65	

After Drier Installation

December, 1921—January and February, 1922

	Total	Per Ton
Garbage treated	2,470 tons	
Coal	347 gr. tons	
Coke for drier	188 net tons	475 pounds
Solvent	12,126 gallons	4.9 gal.
Power and light	$1,934.24	$0.75
Labor Costs	$7,292.60	$2.95
Water	$ 25.43	

Fixed charges, such as cost of supervision, depreciation, etc., are not included as they were not affected. The largest saving was in the solvent used, there being a reduction from 11.95 gallons per ton

of garbage treated to 4.9 gallons, due to the reduced cooking period. Future operating costs will show a further reduction in fuel consumed, due to the fact that the second set of figures includes a considerable quantity of fuel burned while the installation was being made to warm the plant. It will be noted that a slightly greater volume of garbage was handled in the second period at a slightly lower labor expenditure, and there is some reduction in the items of power and light and water.

The deodorizing equipment has been put to rather severe tests with entirely satisfactory results. On one occasion we placed in the drier such strongly odorous materials as putrid meats, rags, hair, feathers, etc., and while the deodorizer was in operation no odor issued from the duct. The photograph shows Mr. Schindler standing in the vapor discharge from the drier, there being detectable neither odors nor chlorine. Following success with this installation in reduction plants, a number of installations have been made for the destruction of odors from private rendering plants.

Explosives in Producing Crushed Stone*

It is not the price per pound of the explosive that is so important, but the cost per ton or yard of stone produced; not even the explosive cost per yard of the material as blasted but the final cost on the cars, which includes drilling, blasting, loading, transportation, crushing, overhead and all other operating expenses. Blasting affects every item in the cost analysis and if it is not properly done, the cost of each subsequent operation will be higher than it should be.

Drilling to proper depth is of the greatest importance in a quarry. Holes are not generally drilled deep enough below grade. In order to be sure of the proper depth it is advisable to run a line of levels over the floor and on top of the quarry face, establishing permanent bench marks and setting reference stakes at various stations around the face for the drill man. These stakes should indicate the depth to which the holes should be drilled. This little item alone may be worth a great many dollars to the quarryman in a season.

The use of large diameter cartridges is advisable in loading deep well holes and manufacturers can furnish dynamite in all sizes up to 5" in diameter. Large cartridges lighten the labor of loading and permit a higher concentration or greater bore hole density of the explosive in the bore hole. When large cartridges are used, very little tamping of the explosive, and often none at all, is necessary. Tamping here does not mean stemming. If holes are dry the cartridges should be slit lengthwise two or three times and dropped or lowered into the hole. The fall causes the powder to spill out, practically filling the hole. Slitting the cartridges is not advisable when water is present. Make haste slowly in loading the explosives in quarries, especially in large holes.

Do not hurry the work but furnish enough help on the job so that loading will go on with despatch. Such despatch may often result in saving money, especially if the holes are wet, and besides it means disposing of a rather unpleasant and anxious job quickly. From four to six tons of stone is, as a general rule, considered good for primary shooting in well drill work. If the bottom is heavy or if there is a hard toe, it is best to use a higher strength explosive at that point, loading the upper part of the hole with lower grade.

Do not load holes when too near a steam shovel or locomotive, unless a screen or awning is used to prevent sparks or hot cinders from falling into the hole. There have been some very disastrous accidents from this cause alone in the last year or two.

In well drill work the holes are usually drilled and blasted in singe rows. The question often arises whether it is better to blast two or three rows at a time, the holes arranged in staggered order, or one row. Some experienced men think that better results and greated fragmentation are obtained by blasting two rows at a time. Most quarries, however, use the single row system. I am inclined to believe that the single row is best when the face of stone is 50 feet high or over. Below that height, it depends upon local conditions. The general practice within relatively shallow holes, from 20 feet to 30 feet in depth, is to blast from two to five rows at a time in order to break the stone up well and in greater volume so that the track and shovel movements are kept at a minimum.

When more than one row is carried, the holes in the back row should be loaded at least 10 per cent heavier than those in the front for best results. I believe, also, that the spacing between rows should be less than the distance from the first row to the edge of the face. In high faces, I do not think the double row advisable at all. Often, even in quarries where the face is 50 feet or under, only one row is blasted at a time, but a buffer or blanket of stone is carried; that is, a whole or part of a shovel cut from the previous blast left against the face to be shot.

The idea of the buffer is that it offers greater resistance or confinement to the charge and better fragmentation is gained. It is used in many cases, especially in lower faces, to hold back the material so that the stone is piled up high enough for economical working of a steam shovel and to avoid irregular track and frequent moving of track. I believe in a buffer in the lower faces, especially if a shovel is used for loading. Sometimes, however, too much buffer is used and the stone is not thrown out far enough to permit access for the secondary drilling and blasting. The shovel is consequently often held up until the obstruction is drilled and blasted.

It is often better, especially if the stone lies in heavy ledges and there are open seams, and the tendency is for the ledges to move or slide before the full breaking effect of the explosive is gained, to allow the material to be thrown farther out so that secondary treatment can be carried on before the shovel reaches that point. In higher faces, from 50 to 200 feet, no buffer whatever is used nor is necessary. Each blast is cleaned up before another is thrown down.

* Abstracts from a paper read before the Convention of the National Crushed Stone Association, by S. R. Russell.

There are many quarries where the tripod method of drilling is the most economical. This is apt to be true especially in quarries of low face where the full depth can be carried in one bench. It is a method well suited to quarries where the stratification is irregular or pitching heavily, and where it is impossible to maintain regular benches.

In many of the harder limestone, trap and granite quarries, very economical results are obtained by what is known as the snake hole method. Often a face of rock 50 to 60 feet high can be brought down with a single row of bottom holes which are heavily sprung. This method is commonly used in many of our eastern quarries. The holes are drilled horizontally at the bottom of the face of the rock from 20 to 30 feet in depth and sprung heavily. It is best to start the hole about 3 feet above the floor allowing it to dip so that at the point it is just above or at the level of the floor. It is unwise to start the hole too low. A certain dip must be maintained in order to allow water flow to the drilling surface. Therefore, if the hole is started too low, its point may be several feet below the floor level before springing, and this depth is increased considerably after springing.

Spring holes are usually spaced about 8 feet apart. A strong quick explosive is best suited for springing holes. The first charge should consist of not more than three cartridges of 1¼ x 8-inch dynamite. If there is drill muck or water in the hole this charge will not do much more than clean out the hole and will have a very slight heating effect on the walls of the hole. If the hole is dry, this charge will enlarge it somewhat at the back and heat the walls. In the first case when hole is wet, it is unnecessary to wait longer than one half hour before loading the second charge. If the hole is dry, it is advisableto wait one hour.

The second charge should consist of, say six cartridges and after firing, 1½ hours should be allowed to elapse before loading the third springing charge. Each subsequent springing charge is increased so that the chamber or pocket made by the preceding one is filled, or perhaps it is best to let the explosive rise a few inches more each time until the necessary size chamber is obtained. Compressed air may be blown into the hole after springing. The air, besides blowing out a great deal of pulverized rock, hastens the cooling of the hole, making work safer and quicker.

Many accidents have been caused by loading the final charge of explosive in the bore holes too soon after springing, the charge taking fire from the heat of the hole. It is, therefore, good policy to wait long enough and to be sure that the hole is cool. A rough idea of the temperature can be gained by allowing the tamping stick to stand in the hole about five minutes and then feeling the end of the stick with the hand to find out whether it has become warm. To be absolutely sure, the intervals between charges should be one, two, three, four, five hours after the first, second, third, fourth and fifth charges.

It is seldom necessary to spring more than five times. I would advise waiting after the last springing is done until the following day before loading the holes.

A strong, quick explosive like 50 or 60 per cent Straight N. G. is best for springing in hard rock. For loading the chamber an explosive of lower strength and slower action is best.

For a secondary drilling, rotating hammer drills are most satisfactory and are now generally used. It is good practice to drill the large stone rather than to resort to adobe blasting, or mud capping. It requires about 20 per cent as much dynamite loaded in a block hole to break a stone as it would require to "doby" it. Moreover, an explosive of lower strength than is used for primary shooting can be used for block hole work. Whereas, a strong, quick explosive is required for mud capping, a 20 per cent or 30 per cent ammonia dynamite is advised for block holes in the dolomites or hard limestones, and nothing higher than 40 per cent. for traps or granites.

Mud capping should not be allowed except in emergency, for it is very wasteful. When mud capping is practiced the cost of secondary blasting averages about four tons per pound of explosive, while block hole work the cost runs from 15 to 18 tons per pound of explosive.

Only the best blasting accessories should be used in connection with explosives. Great care should be exercised in testing electric blasting caps and in making connections, the joints being made tight, clean and dry. Only series connections can be made when blasting machines are used as a source of current, because these machines are designed only for series firing, having a low amperage—about 1½—and a voltage sufficient to fire their rated capacity.

It is best to fire big blasts with a power or lighting circuit. Either direct or alternating current of 25 cycles or over will do. It requires 1½ amperes to fire any number of electric blasting caps in series, but this strength of current must be maintained all along the circuit. Therefore, the greater the number of caps in series, the higher the voltage or pressure necessary to hold the current up. 1½ amperes and a voltage equivalent to 1½ times the number of caps in the series should be supplied.

It is better, however, when power is used for firing, to connect electric detonators in parallel or parallel series. When straight parallel is used, which I like best, in well drill work with electric blasting caps, 1½ ampere should be provided for each cap in the circuit. In this case a high amperage but a low voltage is required. In parallel series, at least 1½, and better 2, amperes should be provided for each series.

In priming deep well drill holes, it is advisable to use sufficient detonators distributed along the charge both to assure thorough detonation and to afford a way out in case one should be broken during loading. At least two caps should be loaded in any bore hole, for assurance.

Cordeau-Bickford or detonating fuse is coming into general use for firing large blasts. Cordeau is especially well adapted for well drill hole blasts and is a very safe, sure and efficient detonator. It is besides very easy to manipulate. Cordeau consists of a lead tube about .22 of an inch in diameter, filled with T. N. T. It has a rate of detonation of about 18,000 feet per second and is therefore of great value as a detonator in quickening slow explosives and assuring complete detonation of explosives of low sensitiveness.

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CONTENTS

CONSTRUCTION OF LOCH RAVEN DAM. Illustrated. By Wm. A. Megraw..... 437
DALLASTOWN ASPHALT-CONCRETE HIGHWAY. Illustrated 439
ENGINEERS' PLANS FOR STATE HEALTH BOARDS 440
ODOR ELIMINATION AT NEW BEDFORD GARBAGE PLANT. Illustrated. By W. J. Springborn 442
EXPLOSIVES IN PRODUCING CRUSHED STONE 443
EDITORIAL NOTES..... 445
Dam Concrete Plants—Adapt the Tool to the Work—En Route to Normalcy.
Road Construction in the Movies..... 446
Health Value of City Zoning..... 446
EXCAVATING TUNNEL CLAY WITH PNEUMATIC TOOLS. Illustrated..... 447
Take Advantage of Coal Strike..... 448
Construction in May..... 449
STONE SLAB ROADWAY IN CHINA. Illustrated 449
CONCRETE PLANT FOR SPRINGFIELD BRIDGE. Illustrated..... 449
Sand-Clay, Gravel and Top Soil Roads..... 451

Dam Concrete Plants

The site of a dam, with hills rising at either end and large masses of concrete to be placed in a comparatively limited area, often offers exceptionally favorable opportunity for the use of gravity and stationary machinery in handling concrete aggregates and the finished product, thus eliminating much of the labor needed under other conditions. Several works constructed under this condition have been described in PUBLIC WORKS, and another is described in this issue—the Loch Raven dam.

In this work, rock quarried half a mile from the dam was hauled by dinkie to the dam site and dumped directly into a large crusher, from which the crushed stone was transported directly to the bin by a belt conveyor. Sand brought by motor trucks was dumped directly into a hopper feeding onto a belt conveyor that filled the sand bin. These bins discharged by gravity into the mixers, which in turn discharged into buckets which, raised by engine power in towers, discharged into chutes which reached by gravity all parts of the dam, except the extreme end furthest from the mixer, which was reached by chutes served by a secondary tower.

Thus neither sand, stone nor concrete was handled other than by machinery after being loaded at the quarry and pit, and a much less number of men was required for mixing and placing this 300 to 700 cubic yards a day than is employed for turning out a half or a third of that amount on a pavement construction job.

Adapt the Tool to the Work

The pick and shovel are generally looked upon as the standard hand tools for all excavating except rock; and drills, either hand or power, for rock work of all kinds. But the contractor who is wise is always on the alert to recognize opportunities for adapting other tools or methods to conditions or materials out of the ordinary.

Tough clay is one of the materials that a pick does not serve well for. A number of years ago a laborer on a tunnel being dug through such material sharpened one edge of a steel barrel hoop and, using it like a spoke-shave, gave an idea to his employer which changed the contract from a losing one to a winner. Another method and tool, made possible by the general use of compressed air in tunnels, is described in this week's issue. Another contractor, finding rock in a trench of a shaly nature in thin horizontal layers, instead of drilling and blasting, supplied the men with short bars with flat, wide ends which were driven into the horizontal seams and wedged the rock up in layers at much less cost.

En Route to Normalcy

After sixteen months of practically unchecked decline, from the peak in 1920 until February of this year, building costs have been showing a slight upward trend for the past two or three months. This is natural and in fact fortunate. Had the rapid decline of 1921 continued during 1922, construction costs would have reached pre-war values before the end of this year, bringing disaster to all concerned. There has been an unusual amount of construction work this spring, sufficient to produce a shortage of skilled artisans in most sections and a greater demand for common labor. If such result had not followed the price decline of last year the outlook would have been a serious one, as showing lack of confidence in the future; but the very fact that wages and prices are stiffening slightly is a proof of the general existence of a confidence in the outcome ready to take advantage of more favorable prices.

We anticipate that this slight reaction will be temporary only, and that by fall a further decline will begin, but at a less rapid rate than last year's, to be in turn checked, and that this periodic decline followed by check or slight reaction will continue until prices have returned nearly to those of 1910 to 1914. It is to be hoped that this will occur rather than a sudden collapse of prices, the momentum of which might carry the decline below the pre-war average and involve all in the resulting "hard times."

That prices will ultimately return to normal, or where they would have been had the world war not occurred, is indicated by history. It seemed to many

to be probable that the widespread effects of this latest war so far differentiated it from former ones that the same laws would not apply and the whole world would be changed and would never return to even approximately former conditions. But the four years so far passed seem to show that history is again repeating itself and that the war has caused merely a bump, although a big one, in the curve of industrial progress.

Some manufacturers are still holding up prices to a degree that seems unwarranted, and the lagging in their decline should be hastened in some way, for the good of the public works depending on them. For instance, in 1914, pig iron was $12.40 per ton and cast iron pipe was then $20 a ton. Now, with pig iron at about $20, cast iron pipe is about $45; a difference of $25 a ton to cover manufacture, freight, etc., as compared to $7.60 eight years ago, or more than three times as great, although both labor and freight are considerably less than twice as high. Or, expressed as percentage, cast iron pipe in 1914 cost about 60 per cent more than pig, while now it costs about 125 per cent more. And there are other materials that show a similar hesitancy to keep step with the procession in the return to normalcy.

Road Construction in the Movies

One of the late "releases" is that made by the Department of Agriculture, and shows in several films of moving pictures the various stages of construction of the three most common types of pavement—asphalt, brick and concrete.

As an illustration of how the subjects are treated, the brick picture shows the mining, grinding and mixing of the clay or shale; the cutting, burning, sorting and testing of the brick; and finally several methods of laying brick pavements—on natural soil, concrete with sand cushion, monolithic, etc., and with cement filler and bituminous filler.

By means of these pictures the general public, through farmers' granges, civic associations, and the like, will undoubtedly learn much about modern highway construction.

Health Value of City Zoning*

The movement for the zoning of American cities has made such speedy progress since the districting of New York City in 1916 that, at the present time, more than forty cities have zoning ordinances in effect, while scores of other cities are engaged in various stages of the preparation of zone plans. * * *

In but few American cities has there been an adequate study co-ordinating the various factors of the city plan. The arrangement of railway terminals, the location of thoroughfares, the needs of local transportation and the requirements for recreation space have been all too often either entirely neglected or given consideration as separate problems of city growth, rather than as co-ordinated features of the comprehensive city plan. Still less has there been conviction that the use and arrangement of private property in the interest of the whole community was a necessity. * * *

Two essential principles for reguluating city growth are embodied in zoning ordinances:

First—The division of the entire area of the city into districts or zones, classified according to the predominant uses of buildings into three main divisions, residential, business and industrial.

Second—The regulation of the height and volume of buildings, the amount and distribution of space to be kept open around them and, in the case of dwellings, the number of persons or families who may live in them, all in conformity to a graded scale of intensity, so that more light and air is secured in the outlying districts, where land values are low, than in congested quarters where land is expensive

The setting apart of zones or districts for the various classes of uses to which buildings are put has health significance in respect to the avoidance of major and minor nuisance conditions about the home, and the decrease of overcrowding on transportation system by locating home in districts within walking distances of working places. * * *

Since zoning laws are not retroactive, they will not, for a long period of years, afford relief from present nuisance conditions, but will prevent the entrance of nuisance producing industries into existing and newly occupied residence neighborhoods. * * *

Among the conditions prescribed for housing projects to receive government aid in England has been a limitation allowing eight families per acre for suburban conditions, and twelve, sixteen and twenty-four families for urban. * * *

Up to 1922 the regulation of intensity of development in the United States has been brought about only through such indirect methods as prescribing the percentage of lot area which a dwelling could cover, and the sizes of yards and courts to be left open. The zoning ordinance of Newark, N. J., effective January 3, 1920, introduced here provisions for direct control of overcrowding on the land. The standard set in that ordinance was 25, 105 and 10 families per acre. * * *

Later ordinances show an actual limitation of intensity of occupation, as, for example, that proposed for Cleveland, Ohio, where unit areas varying from 312 square feet to 5,000 square feet (including half the street and alley widths) are allotted to one family. * * *

The zoning of cities translated into health value would mean:

1. Less discomfort from smoke, odors, noise, dust and flies, and, therefore, to some extent greater vitality and better health.

2. Less crowding of public conveyances and so less contact infection.

3. Less darkness and better air circulation on the street surface, with fewer live pathogenic bacteria in street dust.

4. Less shadow on the dark side of buildings and in the spaces about buildings, which means more light and improved ventilation in rooms.

5. More cheerful outlook from the home and greater cheer within. * * *

* Excerpt of an address by Charles B. Ball, Chief Sanitary Inspector, Department of Health, Chicago.

Excavating Tunnel Clay with Pneumatic Tools

Information concerning the use of such tools in excavating hard clay, particularly in tunnels, given in response to an inquiry on the subject

Public Works:—

Dear Sirs—If possible I would like some information on sewer tunnelling using air hammer equipped with a special tool similar to small spade. I want to know the approximate cost per cu. yd. with this method. Also on how small a tunnel this method would be profitable. Also the size air hammer used and the design of the spades used with the air hammer.

Quite some time ago I read about this method being used in Chicago and Detroit, but the articles were indefinite, not giving any details.

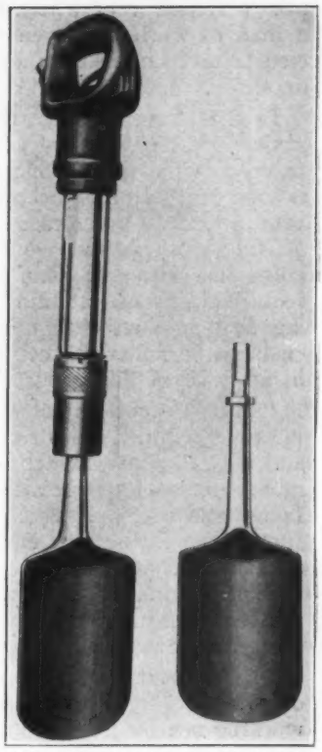
—

The use of pneumatic tools for excavating hard clay, particularly in tunnel headings, is rapidly becoming very popular and has proved convenient, efficient, safe and economical.

Special tools are provided by the pneumatic tool makers and air compressor manufacturers that can now be purchased as standard equipment and have given excellent satisfaction.

In some cases pneumatic coal picks have been used to penetrate hard strata and provide for the insertion of bars by which the material can be pried off in chunks. In other cases the clay is excavated without boring or drilling by means of a small spade-shaped tool such as is referred to in your inquiry, which is driven, similarly to a pneumatic hammer, by a small pneumatic piston that causes it to strike rapid blows and cuts through very stiff material.

As both of these tools are easily portable, light appliances of small dimensions and readily handled by a single man, they can be used to advantage in any tunnel, heading or drift or in



LITTLE DAVID PNEUMATIC HAMMER AND SCOOP

EXCAVATING HARD CLAY IN HEADING WITH PNEUMATIC COAL PICKS WITHOUT THE USE OF EXPLOSIVES
MILWAUKEE WATER WORKS TUNNEL

pits or trench work where there is room enough for a man to work and even where there is not sufficient clearance for him to use an ordinary shovel or spade.

In the Detroit district the soil tunnelled through varies greatly, from a very soft pumice-like clay to very hard clay. In one section medium hard clay is found full of sand pockets and ordinary hand excavation requires great care on account of the danger of falling roof, and work executed with monkey holes and power or hand knife was hazardous and required constant attention to timbering and sheeting. In this case the use of the pneumatic clay digger enabled the miner to feel his way along and timber in advance of dangerous conditions.

A 10½-foot diameter sewer is now being built in tunnel within a mile of the above mentionel locality and is being excavated through clay so hard that no other method of removal has been found as satisfactory as the pneumatic diggers, one of which is supplied to each of six men in the heading and produces a total output of about 66 cubic yards per day with a maximum of 16 yards per day against the previous maximum of 6 yards per man per day before the pneumatic spades were installed.

These results are so satisfactory that a number of other contractors in the vicinity that had been working nearby for more than a year and distrusted the pneumatic diggers, have become converted and have now purchased them and find that by their use the cost of excavation has been reduced at least 40 per cent.

The spade-shaped pneumatic diggers manufactured by the Ingersoll-Rand Co., are 34 inches long overall, weigh 27 pounds, have a cylinder bore of 1¼ inches and a 3½-inch stroke. They consume from 22 to 38 cubic feet of air per minute at a pressure of from 60 to 100 pounds and make about 750 strokes per minute.

The amount of air consumed is about equivalent to that required for a riveting hammer and is somewhat less than is necessary for the operation of a Jackhammer drill. They can be operated by any adequate supply of compressed air.

A recently completed section of the Linwood avenue water supply tunnel in Milwaukee was excavated with a full size semi-circular top heading 11½ feet in diameter. This was driven through hard, stony clay with pockets and strata of waterbearing sand, quicksand and gravel, in wavy strata substantially horizontal. The clay was found to be frequently stratified with alternating seams ½ inch to 3 inches thick, filled with waterbearing sand and having occasional pockets of sand and gravel.

In the face of the heading inclined holes were driven close together by three Kellar and Ingersoll-Rand pneumatic coal picks, as indicated by the accompanying illustration. Afterwards steel bars inserted in these holes were used to pry off solid chunks of the clay, which were thus removed without blasting or laborious cutting. The heading was excavated at the rate of 10 to 12 linear feet daily and the bench was excavated in the same manner, except that the holes were driven in vertical planes. The excavated material was shoveled by hand to dump cars hauled by mules. As fast as the heading was advanced the roof and side walls were supported by a segmental lining outside of the final concrete lining, which was composed of three-inch planks set on 4 x 6-inch longitudinal sills. This tunnel was driven and the concrete lining placed for a unit price of about $67 per linear foot of completed tunnel. Its construction was illustrated and described on page 407 of PUBLIC WORKS, November 26, 1921.

Take Advantage of the Coal Strike

The following notice has been sent by Frank F. Rogers, State Highway Commissioner of Michigan, to call to the attention of "all contractors who have been awarded or will be awarded state road contracts" the desirability of taking immediate advantage of the surplus of open-top cars caused by the coal strike. Similar notices have been sent to the members of the Southern Pine Association and other wholesalers of building materials. All such, as well as engineers in charge of construction work, should give this matter their serious attention at once.

"The coal strike has had a noticeable effect upon the supply of freight cars, particularly in respect to the open-top cars, the surplus of open-top cars having increased materially during the past two months.

"It is safe to assume that this increase has been largely due to the coal strike and that as soon as the strike is settled the surplus will be rapidly depleted as the cars will be returned for the hauling of coal; and it is not improbable, considering these facts in addition to the large volume of construction work under way, that there may be a car shortage later in the season.

"We therefore consider that it would be excellent policy for contractors to take advantage of the present surplus of cars and stock materials as rapidly as possible so that there may be no possibility of a let-up in construction operations later in the season.

"We also believe it would be advisable to stock cement as a further continuation of the coal strike may deplete the present stocks of cement, and the settling of the coal strike with the revival of business thereby, may cause a really serious car shortage. We therefore believe that the expense which would be necessary for the adequate storage of cement would be entirely justified under present conditions. We feel that contractors can particularly afford this expense this year in view of the fact that they do not have any money tied up in cement on paving jobs as the cement is furnished under state contract.

"We therefore trust that you will consider this matter very carefully and place immediate orders for as large a volume of shipped-in materials as you can handle on your jobs.

"I also think it advisable for you to keep the stock of materials in reserve until the amount of such material is just sufficient to complete the work, and use current shipments for current operations rather than stock some materials and begin immediately to use such materials in the construction.

"The Department will co-operate with you in every possible way to further the rapid completion of your contracts and we will be pleased to confer with you relative to any of your particular problems along this line."

Construction in May

According to the F. W. Dodge Co.'s review of building construction in the northeastern states for May, the total was $362,590,000 which was 50 per cent. greater than for the corresponding month last year and 3 per cent. greater than for April.

From January 1st to June 1st the total is $1,352,965,000, being 61 per cent. ahead of last year, and the highest record for the first five months of any year. The maximum figure was for the central west, $103,533,000, and the report for New York State and Northern New Jersey was $88,295,000 which is 53 per cent. higher than for May of last year, but 13 per cent. lower than for last April.

Stone Slab Roadway in China

The illustration shows a highway in China constructed of heavy stone slabs nearly six feet long used for the comparatively light loads drawn by coolies in two-wheeled vehicles or carried by them as shown in the illustration. Under such traffic the road should, it would seem, last as long as the Chinese wall. This road is on Hanam island, opposite the city of Canton.

For the photograph we are indebted to Prof. M. M. Skinner, who is spending two years in China developing a school for commerce at the Canton Christian College and who is foreign commercial adviser of China.

STONE SLAB HIGHWAY IN CHINA

Concrete Plant for Springfield Bridge

Aggregate for 54,000 yards of concrete dumped from High Street Railway Trestle to storage piles and derricked to mixer bins. Concrete mixed at central plant, hauled by locomotives on low-level service track full length of bridge, hoisted in floating tower and spouted to forms.

The 1,494-foot highway bridge, now being built by the Commissioners of Hampden County across the Connecticut river from Springfield to West Springfield, of which Fay, Spofford & Thorndike are engineers, has already been described in the issue of PUBLIC WORKS for May 20, and the construction of the piers and abutments in the issue for June 10. This article describes the concrete plant used by the principal contractor, H. P. Converse & Co.

MATERIALS

The 100,000 barrels of Portland cement obtained from Hudson, N. Y., and from eastern Pennsylvania, are delivered by rail and hauled by motor truck to the contractor's main yard at the West Springfield end of the bridge and stored in a shed of 12,000 barrels capacity. The total amount is equivalent to 425 carloads, of which the maximum amount used is about three carloads per day.

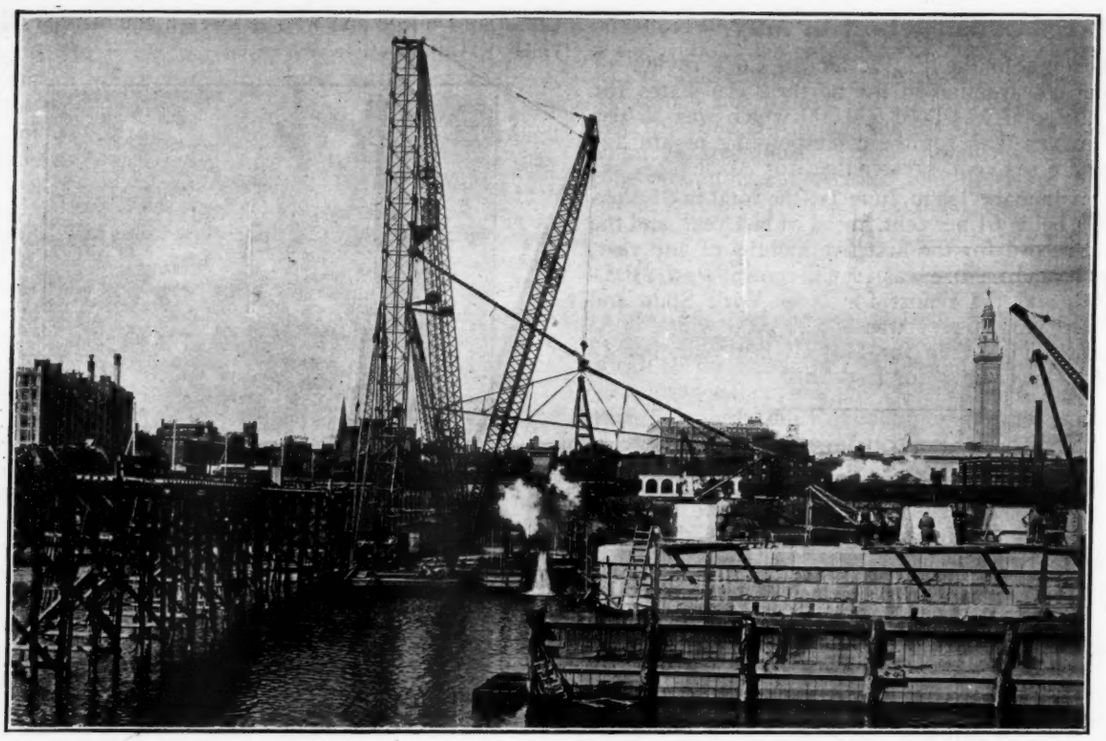
The 73,00 tons of broken stone, equivalent to 2,430 carloads, making a single railroad train twenty miles in length, is furnished by the Holyoke Street Railway Co. from the Mt. Tom, Holyoke, and Lane Notch, Amherst, quarries. The same company also furnishes the greater part of the 30,000 yards, or 1,350 carloads of sand from the company's sand pit between South Hadley and Granby.

Stone and sand are delivered by dump cars on a curved trestle about 15 feet above the surface of the ground for a length of about 300 feet. The concave side of the trestle is faced with horizontal planks forming the side of a storage bin having a maximum capacity of about 1,300 yards of sand and 2,500 yards of stone deposited in the shape of a segment of a circular bank concentric with a stiff-leg derrick having an 80-foot boom equipped with a one-yard clam shell bucket that supplies the 100-yard hopper-bottom storage bin on the top of the mixing tower, adjacent to the cement shed.

A sand and gravel screening plant with a capacity of 400 yards per day has been provided by the contractor to supplement the pit sand and last season furnished 7,300 yards of sand and 9,000 yards of gravel, at estimated costs of about $.80 and $1.60 per yard, respectively.

MIXING AND DISTRIBUTING PLANT

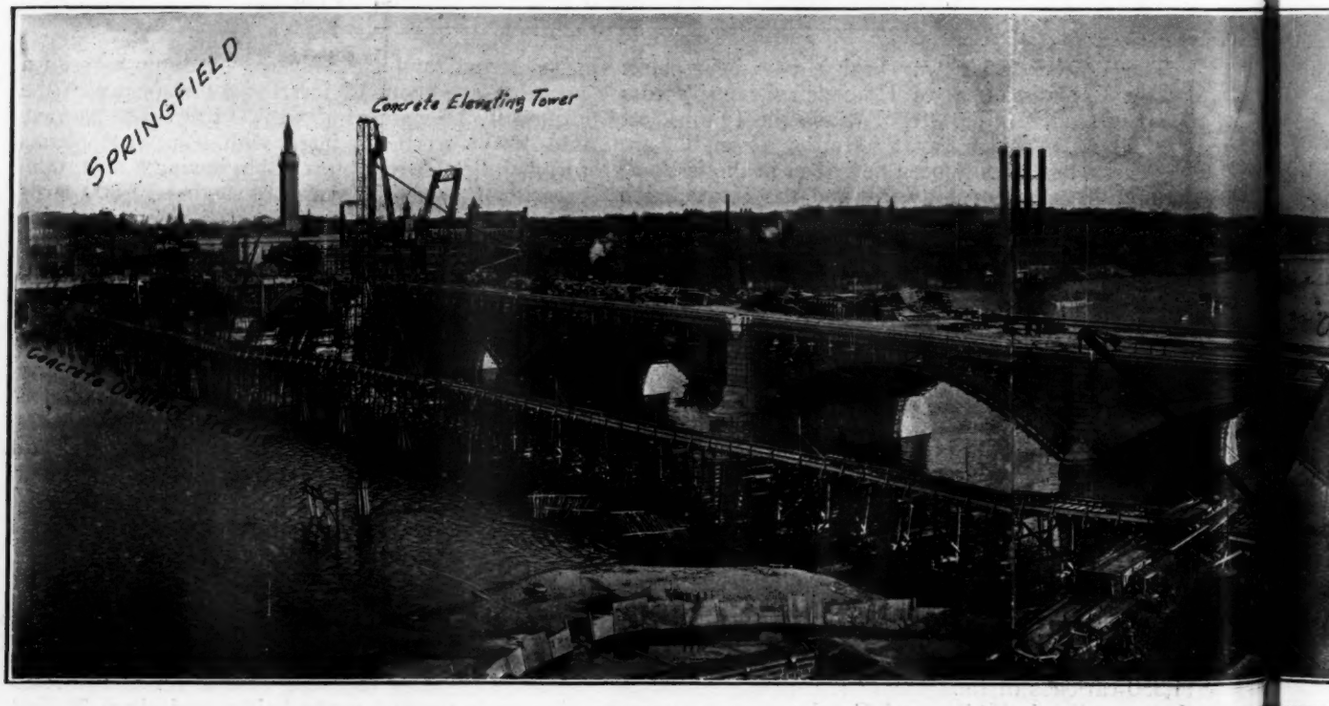
The concrete is all mixed in a 3/4-yard Smith mixer installed under the bins and discharging directly into special two-batch (50-foot) steel cars hauled in two-car or three-car trains by Cummings' gasoline locomotives operating on a narrow gage service line 1,000 feet long carried on an upstream pile trestle parallel to the bridge and about 70 feet



FLOATING DERRICK AND HOISTING TOWER MOORED BETWEEN SERVICE TRACK AND BRIDGE

distant in the clear from it to provide passage between the bridge and the trestle for the contractor's floating elevating tower.

The concrete cars have hopper-bottom bodies with cylindrical side gates operated by hand levers. Each is furnished with a short chute that delivers the concrete to the hoisting tower for the river spans. This steel tower is 130 feet high and is installed on a 36x75 foot barge, seven feet deep. The top is braced by two stiff legs that may later serve also for steel booms 100 feet long. The tower is intermediately braced by four smaller inclined struts and is equipped with a bucket of 27-cubic feet capacity that is hoisted at a speed of 180 feet per minute by the hoisting en-



GENERAL VIEW OF INSTALLATION OF PLANT AND EQUIPM NSTR

gine. The hoisting buckets empty automatically into a vertically movable receiving hopper that supplies a three-section steel chute of the Insley type that is supported by shear legs and commands an area of about 100-foot width, that serves to deliver concrete to any part of the adjacent pier, arch rib, or superstructure. For the floor construction some of the concrete was spouted to a movable elevated hopper supplying hand carts at floor level.

The hoisting tower can be shifted conveniently from pier to pier and from span to span as the work progresses, forming a very flexible connection between the mixing plant and the concrete forms and is considered more convenient, economical and rapid than a cableway or industrial track.

An average force of about 30 men was required to trim the stock piles, operate the reclaiming derrick and the concrete mixer, handle cement, run the concrete train and hoisting tower, operate the spouting system and to level and spade the concrete. The best rcord for mixing and placing is 450 yards of concrete in a 16-hour run and the maximum monthly product is about 8,450 yards. When concreting was suspended, November 26, on account of cold weather, the total amount of concrete that had been mixed and poured was about 49,400 yards, 5,765 yards of which had been placed in the arch ribs of seven spans.

Sand-Clay, Gravel and Top Soil Roads

North Carolina has large mileages of clay and gravel roads, which now demand some form of treatment to protect them from the disintegrating effect of modern traffic and the elements. The State Highway Department has found that a material light enough to penetrate the sand-clay, top soil or gravel surface does not have binding quality; and on the other hand that a material which did have sufficient binding quality was too heavy to penetrate the road. In the case of the heavy treatment, the bituminous material went into the formation of a mat on the surface of the road, and the bond between the road and the bituminous mat was eventually destroyed by the dusting up of the surface beneath the mat. The weakness in this treatment was not in the bituminous blanket but in the contact between the bituminous blanket and the road surface.

Undoubtedly this has been the experience of many of the other states having large mileages of these types of roads, and the experiment being conducted by North Carolina will be of interest and value.

The sand-clay, top soil or gravel surface is first softened by sprinkling, and then a single layer of broken stone or gravel approximately 1½ inches in size is rolled into the surface. After giving the surface time to dry out, and in order to secure maximum consolidation, the roadway is opened to traffic for a short period, after which it is swept clean by brooming.

The road then presents an ideal surface for treatment with an asphaltic material, one to which a material possessing the desirable binding qualities may be applied without danger of being separated from the road surface by the dusting up of the surface as a result of the impact of traffic.

The North Carolina State Highway Department has been using Texaco No. 55 Road Oil in its experiments, and while the new construction has not been subjected to traffic long enough to say that it has proven absolutely satisfactory, it is anticipated that the result will be a waterproof, durable and resilient mat which will add considerably to the efficiency and life of sand-clay, top soil and gravel roads.

IPME NSTRUCTION OF SPRINGFIELD-WEST SPRINGFIELD BRIDGE

NEWS OF THE SOCIETIES

CALENDAR

June 19—AMERICAN CONSTRUCTION COUNCIL. Organizing meeting. Washington, D. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 20-23—SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual convention. University of Illinois.

June 21-22—LEAGUE OF MINNESOTA MUNICIPALITIES. Annual convention. Crookston, Minn.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

July 12-14—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Exhibition. Auditorium Bldg., Springfield, Mass.

Aug. 15-18—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Fiftieth convention. Municipal Auditorium, San Francisco, Cal. Secretary, James J. Mulcahey, Chief, Yonkers, N. Y., Fire Dept.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 12-15—NEW ENGLAND WATER WORKS ASSOCIATION. 41st annual convention. New Bedford, Mass. Secretary, Frank J. Gifford, Tremont Temple, Boston, Mass.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 1-6—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beck, Chicago.

Dec. 7-13—NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

At the annual convention to be held at the University of Illinois June 20-23, prominence will be given to a discussion of the importance of a study of the English language in the regular engineering courses, to the broader aspects of engineering education and to graduate work in physics.

The College of Engineering will be opened to the convention, various inspection trips to engineering projects and interesting points have been planned and there will be an annual dinner June 21 and a smoker June 22.

RENSSELAER POLYTECHNIC ASSOCIATION

At the regular monthly dinner meeting in New York June 5 the guest of honor was Dr. J. A. L. Waddell, consulting engineer of New York and Kansas City who had just returned from more than a year's absence in Asia and Europe and described some important engineering work he had investigated there, especially the great proposed Yellow River Government Bridge for which a large number of competitor designs were submitted to the international commission of bridge experts, which he headed. Dr. Waddell considered the best of these designs far inferior to American up-to-date practice and opposed the award of a contract to any one of them. He mentioned various other important bridge and railroad projects in China and Hindostan and described some of the difficult conditions encountered by the commission.

AMERICAN ASSOCIATION OF ENGINEERS

At the eighth annual convention in Salt Lake City, Utah, June 5-7 the important feature was the attention devoted to the importance of publicity for general educational advance and for improving politics. The necessity for perfection of publicity machinery was emphasized and improvement and extension of the employment service of the association was provided for.

The officers elected for the coming year are: president, A. N. Johnson; vice-presidents, G. E. Taylor and A. M. Knowles; directors, B. W. Matteson, W. S. Boyle, W. N. Peyton and C. A. Poole.

INSTITUTE OF AMERICAN ARCHITECTS

The 51st annual convention was opened in Chicago June 7. Prominence was given to the desperate labor conditions and unsatisfactory industrial relations prevailing in Chicago which have made building costs there almost prohibitive. The difficulty was illustrated by the fact that 600 guards are required to protect 12,000 imported mechanics and that 1,000 more policemen and 6 more judges have been provided for.

The subject of jurisdictional awards in building construction was discussed and 90% of the delay in building jobs was attributed to jurisdictional disagreements.

The American Institute of Architects unanimously voted alignment with the American Construction Council.

DETROIT BUILDING SHOW

The first Detroit annual Better Homes and Building Exposition May 20-28 was participated in by more than 200 exhibitors and featured the displays of the city plan commission architects and construction organizations.

LOUISIANA ENGINEERING SOCIETY

The technical exercises of the June meeting consisted of an address on "Radio" by Dr. Daniel S. Elliott, Professor of Physics at Tulane University.

AMERICAN FEDERATION OF LABOR

The convention of the building trades department was opened in Cincinnati June 7 and the president was in favor of the proposed national construction council to be composed of the ten principal elements of industry including as units, materialmen, architects, financiers, contractors, engineers, public utility officers, public officers and labor. It was stated that there is a pronounced desire among building labor for co-ordination of the units and a belief that it would bring peace over a greater portion of the year.

President Gompers is reported to have severely criticised the U. S. Supreme Court and to have recommended labor organizations to avoid recourse to courts excepting when compelled to appear as defendants.

THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

At the 14th semi-annual meeting to be held at Niagara Falls, Ont., June 19-21 there will be presented various technical papers. The business session of June 20th will be held on board the steamer en route to Toronto, where various plants will be visited. On June 21st, there will be a technical meeting at the Hotel Lafayette, Buffalo, with excursions to industrial plants in the afternoon.

LUMBERMEN'S CONVENTION

The inter-association convention of the Ohio and Northeast Lumber Associations will be held on the steamer Moronic June 16-23, which will cruise from Toledo, Ohio, to Duluth.

BUILDING CONTRACTORS

The executive committee of the Association of Building Contractors for the Third District of Illinois met at Quincy May 25th and discussed the skilled labor shortage and apprenticeship situation on which final action was deferred until the next meeting. The legislative committee outlined a course to deal with the mechanics lien law and the plumbers' license enactment. Governor Allen discussed "Industrial Relations Court in Kansas" and stated that "when an essential industry is in controversy that threatens the cessation to the detriment of public welfare the court of industrial relations may take charge of the controversy and find a decision as to wages and working conditions which shall be just and equitable. The law holds that the right to work is just as sacred as the right to loaf and that it is the duty of government to protect men in their natural inclinations on this subject."—The law holds that "there shall be no conspiracy either on the part of the laboring men nor of the operators to close down as essential industry"—essential industries may close for seasonal purposes but are forbidden to shut down for the purpose of effecting a wage controversy and are not allowed to lock out or to blacklist.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

PORTABLE MACHINERY FOR ROAD BUILDING

A simple and efficient equipment for handling concrete materials in road building has recently been put on the market by the Portable Machinery Company, and consists for a single unit of a contractor's type scoop conveyor, which is designed to handle abrasive materials, a portable measuring hopper and an auto dump truck which, it is claimed, will completely serve the mixer or paving machine and eliminate ten or twelve men of the usual shovel and wheel-barrow gang.

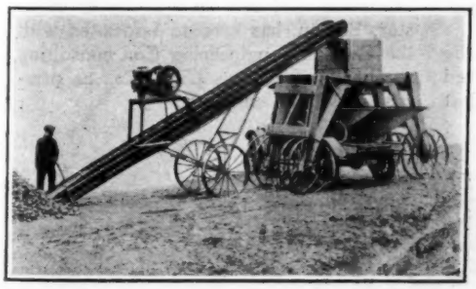
For a small job a single unit will suffice, and the sand and stone piles should be close together along the roadway, near the mixer, so that both may be fed to the same conveyor. One man can feed a specified number of shovels full of sand and the required amount of cement to the conveyor and another man can continuously deliver stone to it until the measuring hopper is full. The contents of the hopper are then discharged into the dumping truck and the latter delivers its load to the mixer and returns for another which is ready for it by the time the truck arrives, thus eliminating all waiting time for loading or unloading the truck or filling the hopper.

For larger jobs it is desirable to use two or more conveyors, hoppers and trucks according to the size of the work and the size of the mixer and the rapidity of its operation.

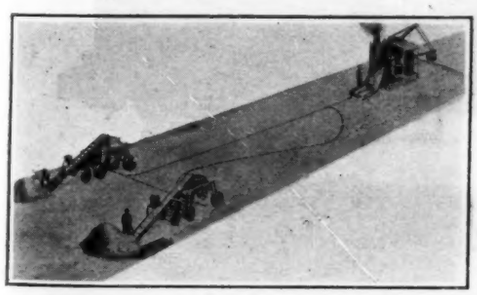
The ideal outfit is two conveyors, two mixer hoppers and two auto dump trucks to provide a reserve in case of any delay for one part of one unit, and makes it possible for one of the conveyors to handle stone or sand from railroad cars or from storage piles to trucks that distribute these materials along the roadway.

In the diagramatic view, one conveyor and measuring hopper handles the stone which is delivered to a truck that is afterwards driven to the sand and cement hopper and receives the remainder of the materials for one batch which it transfers to the mixer and returns for another load.

The measuring hoppers are made adjustable to provide for different proportions of aggregate and, like the conveyors, are mounted on wheels, so as to be easily movable and keep pace with storage distribution of aggregate.



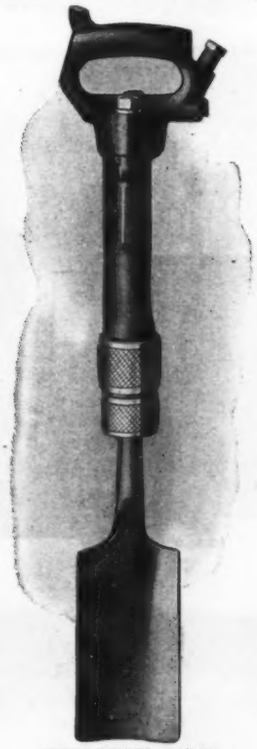
PORTABLE MACHINERY COMPANY'S CONVEYOR DELIVERING AGGREGATE TO MEASURING AND LOADING HOPPER.



IDEAL ARRANGEMENT OF TWO CONVEYORS AND TWO MEASURING HOPPERS SERVING DUMP TRUCKS DELIVERING TO PAVER.

THE SULLIVAN SPADER

The Compressed Air Spader, or Pneumatic Clay Digging Tool, Class "DE-361," manufactured by the Sullivan Machinery Co., consists of a light Sullivan air hammer, weighing only 16 lbs., with a length of 17 inches, and requiring ½-inch air hose. It is equipped with a steel spade and special retaining ring or bushing of the Bronson pattern.



SULLIVAN COMPRESSED AIR SPADER.

This spade takes the place of the hand pick, as well as of the hand spade or shovel in excavating stiff clay in trenches, open cuts, caissons and tunnels in which the ground is not sufficiently hard to be drilled and shot, and yet is too hard to be handled readily by the ordinary pick-and-shovel method.

In tunneling in blue glacial clay, very hard and dry, in the Chicago district, compressed air spades increased the output per miner from 3 to 4 cubic yards per eight-hour shift, to from 8 to 10 cubic yards.

The Sullivan Spader consists of a cylinder, provided at the rear end with a handle secured to it by side rods, and at the other with a special retainer for holding the steel spade in the nose or chuck of the hammer. The hammer or piston runs up inside the hollow, cylindrical valve itself, thus providing a long stroke without excessive length of tool, or undue waste. The drill is operated by pressure on a trigger or thumb throttle placed at the top of the handle grip where its action will not be hindered by an accumulation of mud or grit.

The Spader strikes a hard, snappy blow, giving abundant power for the work to be done, and satisfactory work can be accomplished at any air pressure from 45 lbs. to 100 lbs., although the higher range of pressure is strongly recommended, particularly for stiff ground.

The smoothness of operation of the "DE-361" Spader, its excellent balance, and its freedom from vibration, make it a particularly easy machine to handle, and reduce the element of fatigue for the operator.

It is claimed for the Sullivan Spader that it consumes but little air power per unit of work accomplished, and that this efficiency is maintained after long service; that its smooth operation eliminates undue fatigue, and that it will perform a full day's work over long periods without break-down or necessity for repairs.

CHAMPION PRESSURE HEATING DISTRIBUTORS

The Champion Distributors, made by the Good Roads Machinery Company for mounting on motor trucks, are designed for applying road oils, tar products and dust laying materials.

The distributor unit consists of an encased tank, a battery of burners, a series of pipes, a distributing manifold and a pump which is driven by a power take-off shaft of the motor transmission, and is located directly in the discharge line from the tank.

The standard distributing manifold 8

feet in width, is made in two 4 foot sections so that the material can be applied in varying widths as desired, but it can be furnished any length that may be required up to 16 feet. The manifold is suspended by means of swivel joints so that it can be swung and carried away from the road when not in actual use.

There are only four valves to be operated in the entire piping system. The pipes through which the materials flow from the tank are exceptionally short and are enclosed, thus preventing the material from cooling after it has been properly heated.

Union connections and removable plugs are provided so that any part may be easily detached for cleaning purposes.

Two sets of 12 distributing nozzles are furnished, one of ⅜-inch and the other ½-inch diameter in the discharge opening. The nozzles are so designed and spaced that fan shaped streams overlapping each other deliver on the roadway a solid sheet of material the entire width of the manifold.

The centrifugal pump is installed in a heated compartment and is driven by chain and sprockets from the power take-off of the automobile motor transmission. A large pressure regulating valve is installed in a by-pass line around the pump. A pressure gauge located close to the by-pass valve in the discharge line of the pump shows the exact pressure being maintained.

The material can be pumped from the hauling tank or tank car into the distributing tank or transferred from tank cars to storage tanks.

The heating device consists of a number of powerful specially designed oil burners which will increase the heat of a full tank load of material from 225 to 350 degrees F. in 1½ hours.

The fuel is kerosene atomized by air pressure and is carried in a twenty-gallon tank. A small air pump operated by hand maintains pressure in the fuel tank. Thirty-five pounds is the normal pressure to be maintained, while fifty pounds is the maximum pressure.

The tank used with the Champion Distributor is of steel completely jacketed. A large number of flues extend upward diagonally through the tank.

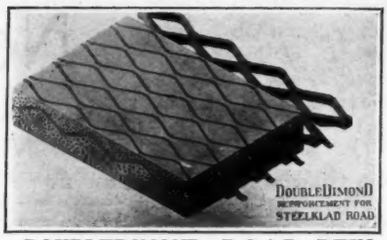
A dome is placed on top of the tank in the center to facilitate loading. Suspended below the base of the dome is a basket-wire screen designed to prevent sticks, debris and other foreign matter from getting into the tank.

The Champion Heating Distributor will handle all kinds of road oils. The lighter oils up to No. 6 when the temperature registers from 70 to 80 degrees can be transferred from tank cars to storage tanks by means of the pump without the necessity of heating the material. No. 6 or lighter oils can be heated from 80 to 150 degrees in from ten to fifteen minutes depending upon the number of unit burners used. In handling heavy oils, should the material be heated initially in the tank car to 225 degrees and then at that temperature be transferred to the tank on the motor, the temperature of the material can be increased at the rate of one and one-half degrees per minute to 350 degrees by the application of heat from the oil burners. Under these conditions, the distributor will easily handle any of the standard road materials.

By varying the speed of the motor truck and the size of the distributing nozzles in the manifold the quantity of material to be distributed may be regulated from one-half to two or more gallons per square yard of roadway.

DOUBLEDIMOND REINFORCEMENT FOR ROADS

This product, manufactured by the Ravenna Steel Co., is a reticulated fabric produced in steel sheets that



DOUBLEDIMOND ROAD REINFORCEMENT.

have a mesh similar to that of expanded metal consisting of parallelograms in one plane that are bisected by diametrical strips set into another plane and affording special anchorage for the fabric in the mass of concrete.

It is designed to strengthen the concrete for flexure, contra flexure, and shear stresses and to distribute surface loads uniformly.

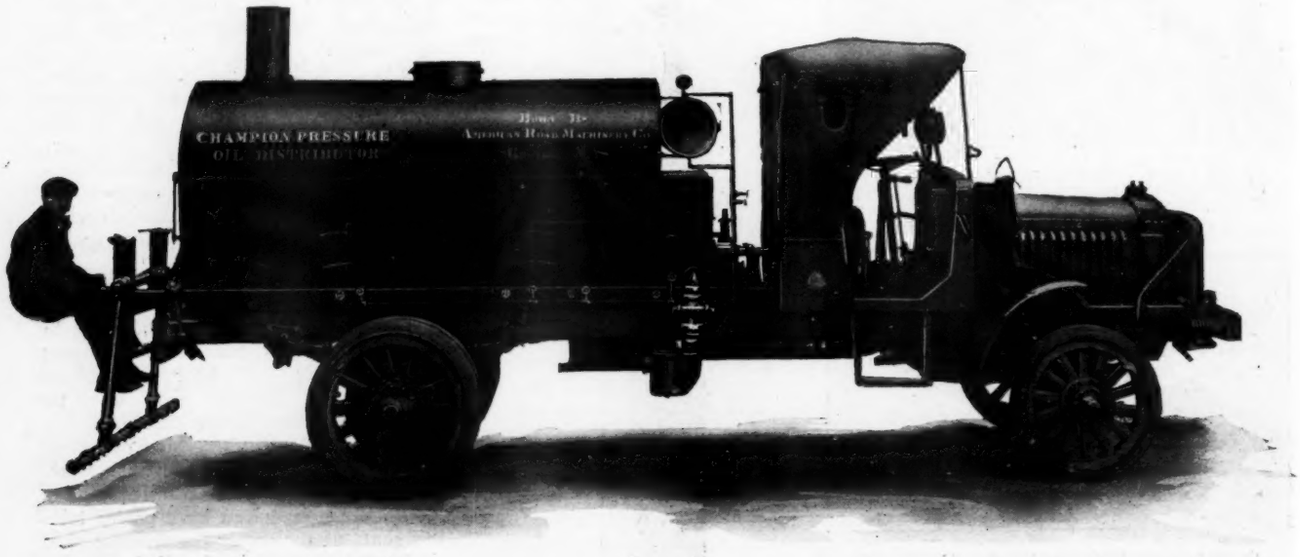
It is intended for use on concrete roads, retaining walls, culverts, docks, foundations, floors, roofs and tanks.

INDUSTRIAL NOTES

The Keystone Concrete Block Co., Rochester, N. Y., has been appointed vicinity representative of the Consolidated Expanded Metal Co., of Braddock, Pa., for the distribution of steelcrete "Rid-gid," metal lath double-diamond road reinforcement, and other specialties.

William S. Moore, formerly city engineer of South Bend, Ind., and Charles W. Cole, a member of the Indiana Board for the Registration of Engineers and Surveyors, have formed an engineering partnership with offices in South Bend.

John G. Hirsch, formerly supervising engineer for Lockwood, Greene & Co., engineers, Chicago, and Stone & Webster, Boston, has become associated with the Benham Engineering Co., consulting engineers of Kansas City, Mo., as principal assistant engineer.



CHAMPION PRESSURE HEATING DISTRIBUTOR WITH TWO-SECTION MANIFOLD FOR HOT APPLICATION OF ALL KINDS OF ROAD OILS.